REMARKS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1-20 are pending, with claims 1-2, 6-8, 11 and 15-17 amended by the present amendment. Claims 1, 8 and 17 are independent.

In the Official Action, the restriction was withdrawn; claims 1, 5-8 and 14-18 were rejected under 35 U.S.C. § 103(a) in view of Hallberg (U.S. Patent No. 6,658,199) and Guttman (U.S. Patent No. 7,031,259); claims 9-10 were rejected under § 103(a) in view of Hallberg, Guttman and Ando (U.S. Patent No. 6,453, 116); and claims 2-4, 11-13 and 19-20 were indicated as containing allowable subject matter.

Applicant acknowledges with appreciation the indication of allowable subject matter.

Claims 1-2, 6-8, 11 and 15-17 are amended to more clearly describe and distinctly claim Applicant's invention. No new matter is added.

Briefly recapitulating, amended claim 1 is directed to

> In a system recording and playing back a transport stream transmitted by a digital broadcast, a digital video record/playback apparatus comprising:
>
> an output control unit configured to output a predetermined playback mode;
>
> a transmission control unit configured to control a transmission bit rate and transmission time point of the transport stream based on the predetermined playback mode and buffer status information;
>
> *a demux configured to perform a STC (system time clock) count initialization on a PCR (program clock reference) packet of the transport stream inputted via the transmission control unit, the demux configured to synchronize the STC count with a STC,* the demux further configured to extract ES (elementary stream) data for a program data packet of the transport stream;

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a buffer configured to temporarily store the extracted ES data, the VBV buffer configured to play a role in buffering between the transmission bit rate and a decoding frame rate, the buffer configured to output a buffer status to the transmission control unit; and

a decoder configured to adjust DTS (decoding timestamp) according to the predetermined playback mode of the output control unit, the decoder configured to control a decoding time point by comparing a difference between the adjusted DTS and the STC count value to a reference time and decoding the ES data outputted from the buffer.

Independent claim 8 recites, *inter alia*:

a transmission control unit configured to control a transmission bit rate and transmission time point of the transport stream based on the predetermined playback mode and buffer status information;

a demux configured to perform a STC (system time clock) count initialization on a PCR (program clock reference) packet of the transport stream inputted via the transmission control unit, the demux configured to synchronize the STC count with a STC, the demux further configured to extract ES (elementary stream) data for a program data packet of the transport stream;

a buffer configured to temporarily store the extracted ES data, the buffer configured to play a role in buffering between the transmission bit rate and a decoding frame rate, the buffer configured to output a buffer status to the transmission control unit; and

a decoder configured to adjust DTS (decoding timestamp) according to the predetermined playback mode of the output control unit, the decoder configured to control a decoding time point by comparing a difference between the adjusted DTS and the STC count to a reference time and decoding the ES data outputted from the buffer.

Hallberg describes a method and system for creating a trick play video display from a group of MPEG video transport frames. Referring to FIG. 1B, at the receiver 12, a broadcast signal is demodulated in a demodulator 48. The resulting transport data stream 50 is depacketized and demultiplexed in a transport depacketization and demultiplexing subsystem 52. The transport stream data for the individual elementary data streams are stored temporarily in an

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elementary buffer 54. The data streams for the individual program elements are then decoded and decompressed as appropriate in application decoders, including a video decoder 56 and an audio decoder 58. The decoded data is sent to a presentation subsystem 60 for presentation to the viewer at a time designated by a presentation time stamp associated with each video frame.

In Hallberg, the synchronization of the presentation of the elements of a program is controlled by timing information associated with each frame of the video element and each of the data units for the other elements of the program. On the transmit side (Fig. 1A), there is a program clock reference (PCR) that is a sample of the system clock added periodically to the transport data stream 38 for a program. The PCR is recovered from the data stream at the receiver 12 and used to synchronize the receiver's version of the system clock 55 to the emission station's system clock 33.

At the receiver 12 of Hallberg, the frames of the transport stream are temporarily stored in the elementary stream buffer (EB) 54. The video frames are then removed, decoded and reordered for presentation at the system's frame rate. Since information from certain frames must be available in order to decode later frames, the order of transmission in the transport stream GOP is not the same as the temporal order in which the frames were originally recorded and in which they will be displayed. The decoder must reorder the frames of the GOP before they are displayed. In standard forward play mode the exemplary transport stream GOP illustrated in FIG. 2 would be displayed in the order illustrated in FIG. 3.

The capacity of the elementary buffer 54 of Hallberg limits the bit rate of the transport stream. Frames containing differing quantities of data are received at a nearly constant rate from the depacketization and demultiplexing subsystem 52. The data is stored in the elementary buffer

54 until it is removed for decoding at a time specified by the decoding time stamp (DTS) associated with that frame. If data enters the elementary buffer faster than it is removed for decoding the elementary buffer will overflow and data will be lost. The size of the elementary buffer is *established by an MPEG specified data variable*. Further, the trick play GOP must not require a greater data rate than can be supported by the communication channel 64 between the video recorder 62 and the receiver 12.

In Hallberg, the original MPEG-2 broadcast transport stream is edited at "play time" to create a new MPEG-2 compliant trick play transport stream which can be decoded by a standard MPEG-2 decoder to produce the desired trick play video display mode. Frames are selected from a transport stream GOP for inclusion in the trick play video display. The trick play transport stream GOP contains some of the P- and B-frames of the original transport stream to produce a relatively smooth trick play display. To create the desired trick play display frame sequence, the frames from the transport stream GOP are reordered, repeated, and time stamped again, as necessary. The time required to transmit the new trick play GOP to the elementary buffer 54 is determined and compared to a maximum transmission time which is established from the design limitations for the communication channel 64, an MPEG compliant video decoder 56, and an elementary buffer 54. If the required transmission time exceeds the maximum time permitted, the number of frames in the trick play GOP is reduced until the system is capable of transmitting the trick play GOP within the constraints imposed on the system by its design for processing MPEG video in the forward mode at standard speed.

However, Hallberg does not disclose or suggest any features that perform a STC (system time clock) count initialization on a PCR (program clock reference) packet of the transport

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stream inputted via the transmission control unit and synchronize the STC count with a STC. Instead, Hallberg describes that system time values generated by a system clock 33 are a presentation time stamp (PTS), a decoding time stamp (DTS) and a Program clock reference (PCR).[1] That is, Hallberg does not disclose Applicant's claimed STC count, let alone Applicant's claimed synchronizing. Accordingly, for a first reason Applicant submits that claims 1 and 8 patentably define over Hallberg.

Second, Hallberg does not disclose or suggest any features that adjust a DTS (decoding timestamp) according to the predetermined playback mode. Instead, Hallberg describes that a new DTS is set to the greater of a first value depending upon whether the previous frame was or was not a B-frame and a second potential initial value being the start time of the frame period nearest to, but not earlier than, the current PCR.[2] That is, Hallberg does not disclose or suggest adjusting a DTS according to the predetermined playback mode. Accordingly, for a second reason Applicant submits that claims 1 and 8 patentably define over Hallberg.

Third, Hallberg does not disclose or suggest any features that control a decoding time point by comparing a difference between an adjusted DTS and a STC count to a reference time. Accordingly, for a third reason Applicant submits that claims 1 and 8 patentably define over Hallberg.

In summary, with Applicant's claimed invention, it is possible to implement a trick play of the user-selected direction and speed and to reduce costs without additional appended devices and complicated processing. In contrast, to create the desired trick play display frame sequence in Hallberg, Hallberg requires the frames from the transport stream GOP to be reordered,

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[1] Hallberg, col. 5, lines 13-29.

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repeated, and time stamped again.[3] Thus, Applicant's claimed invention is both novel and useful

relative to the applied art.

Independent claim 17 is directed to

A playback method in a digital video record/playback apparatus, comprising:

a step (a) of storing transport packets of a selected program, picture information, and a PCR (program clock reference) of the selected program;

a step (b) of performing a STC (system time clock) count initialization using a value of the stored PCR and synchronizing the STC count with a STC according to a direction of a trick play mode;

a step (c) of adjusting a DTS (decoding timestamp) of a picture to be decoded according to the direction and multiple-times speed of the trick play mode; and

a step (d) of decoding to output picture data of the selected program by controlling a decoding time point by comparing a difference between the adjusted DTS and the STC count to a reference value and by referring to the picture information according to the trick play mode.

FIG. 6 of Hallberg describes that, if the length of the trick play GOP is acceptable, a new

program clock reference (PCR) is determined for and associated with each frame of the trick

play GOP 94. First, the space available in the elementary buffer (EB) 54 is determined 200. The

current PCR value is compared with the decoding time stamp (DTS) of each frame having a

previously assigned DTS. The DTS specifies the time at which the frame is to be removed from

the elementary buffer to begin decoding. If the DTS value of a frame is greater than the current

PCR value, then the frame remains in the elementary buffer and the frame's size is subtracted

from the total capacity of the buffer to determine the available space in the buffer. After

determining the available space in the elementary buffer, the size of the current frame is

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[2] Hallberg, col. 11, lines 22-48.

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compared to the available space to determine whether the current frame will fit in the buffer 202.

If there is insufficient space in the buffer, the current PCR is set to the earliest DTS value of a

frame currently in the buffer 204. The effect is to delay storage for one frame period, permitting

the oldest frame in the buffer 54 to be removed and the space it occupied to be added to the

available storage space. The available space in the elementary buffer 54 is again determined and

compared to the size of the next frame until there is sufficient space in the buffer 54 for the

frame. When there is sufficient excess space in the buffer 54 to permit storage of the frame, the

frame's PCR is set to the current PCR 206. The current PCR value is then adjusted by advancing

the PCR by the time required to transmit (TX) the frame to the receiver 208. The time for

transmitting a frame is determined by the frame's size and the bandwidth of the communication

channel 64.

Following adjustment of the PCR by Hallberg, a new DTS is calculated for the current

frame 210. Initially, the new DTS is set to the greater of two values. The first value depends

upon whether the previous frame was or was not a B-frame. If the previous frame was not a B-

frame, the initial DTS is set to the previous frame's DTS value plus the time required to decode

the current frame which is assumed to be one frame period. This allows the previous frame to be

fully decoded before decoding of the current frame begins. If the previous frame was a B-frame,

the initial DTS is the previous frame's PTS value. This permits the B-frame to be displayed

before the current frame begins decoding. Failing to wait for the B-frame to be displayed could

cause removal of the B-frame from the decoder's buffer before it can be placed in the buffer in

the presentation subsystem 60. The second potential initial value of the new DTS is the start time

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[3] Hallberg, col. 7, lines 13-16.

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of the frame period nearest to, but not earlier than, the current PCR. Setting the DTS to this value

forces the current frame to begin decoding only on a frame period boundary and only after the

frame is completely received in the elementary buffer 54. If the current frame is a reference

frame (I- or P-frame), the current DTS is further set to the maximum of the previously calculated

initial DTS or the PTS of the oldest of the last two decoded reference frames. Adjusting the DTS

in this manner assures that only two decoded reference frames are allowed to be in storage at any

time in the elementary buffer 54, avoiding buffer overflow.

After Hallberg determines a new DTS for the current frame, a determination is made

whether the current frame will be displayed 212. A frame may be decoded to facilitate decoding

a display frame, but may not itself be displayed. Due to the forward predictive nature of MPEG-2

only the last decoded occurrence of a frame is actually displayed. If a frame will not be

displayed, then it's PTS 214 and temporal reference 216 values are set well beyond the PTS and

temporal reference values of the trick play GOP's last frame. When the subsequent GOP is

decoded, the initial temporal reference value is reset to zero and frames from the earlier GOP

will not be displayed.

If the frame of Hallberg will be displayed, a new presentation time stamp (PTS) is

calculated for the frame 218. The PTS is the moment of the system time at which the frame will

be presented. The PTS for the initial, displayed frame of the trick play GOP is set equal to the

frame's DTS plus the time required to decode the frame. The time required to decode a frame is

preferably assumed to be one frame period. If the current frame is not the first display frame of

the trick play GOP, then its PTS will be set to the greater of either the frame's DTS value plus the

frame decoding time or a target PTS value. The target PTS attempts to position the frame's

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presentation time relative to other frames of the trick play GOP in a position approximately proportional to that frame's presentation time in the frames of the original transport GOP. The purpose of the target GOP is to temporally smooth the trick play video display. The target GOP is determined by an equation that takes into account

- first_frame_PTS = the PTS value of the first frame to be displayed in the trick play display;
- frame_period = the amount of time a single frame is displayed;
- target_GOP_frames = the desired number of frames to be included in the trick play GOP;
- first_temporal_reference = the temporal reference value from the original transport stream GOP of the first frame displayed in the trick play video display;
- current_temporal_reference = the temporal reference from the transport stream GOP of the current frame of the trick play GOP; and
- last_temporal_reference = the temporal reference from the transport stream GOP of the last frame of the trick play GOP.

As the result of this adjustment of the PTS by Hallberg, the elapsed times between the presentation of the first frame of the original GOP that is displayed in both the original and trick play GOPs and a display frame of interest is approximately proportional to the relative lengths of the two GOPs.

However, for the reasons identified above relative to claims 1 and 8, Hallberg does not disclose or suggest performing a STC (system time clock) count initialization using a value of the stored PCR and synchronizing the STC count with a STC according to a direction of a trick play mode. Accordingly, for a first reason Applicant submits that claim 17 patentably defines over Hallberg.

Additionally, for the reasons identified above relative to claims 1 and 8, Hallberg does not disclose or suggest decoding to output picture data of the selected program by controlling a

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decoding time point by <u>comparing a difference between the adjusted DTS and the STC count to a</u> <u>reference value</u>. Accordingly, for a second reason Applicant submits that claim 17 patentably defines over Hallberg.

Applicant has considered the remaining applied references and submits the remaining applied references do not cure the deficiencies of Hallberg. As none of the cited art, individually or in combination, discloses or suggests at least the above-noted features of independent claims 1, 8 and 17, Applicant submits the inventions defined by claims 1, 18 and 17, and all claims depending therefrom, are not rendered obvious by the asserted references for at least the reasons stated above.[4]

CONCLUSION

Should there be any outstanding matters that need to be resolved in the present application; the Examiner is respectfully requested to contact Michael E. Monaco Registration No. 52,041 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

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[4] MPEP § 2142 "…the prior art reference (or references when combined) must teach or suggest **all** the claim limitations.

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If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies

to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional

fees required under 37.C.F.R. §§ 1.16 or 1.147; particularly, extension of time fees.

Dated: April 15, 2009

Respectfully submitted,

By _____

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